

Serial No.:: Not Yet Known
Filing Date: Herewith

separators do not poison the anode and benefit from the high thermal conductivity of the copper material.--

REMARKS

The foregoing claim amendments are made to obviate the problem of improper dependency in the multiple dependent claims which existed in the PCT priority document. The foregoing abstract of the disclosure was added because no abstract appeared in the PCT priority document. Appended hereto at page 4 is a marked-up version of the foregoing amendments in which additions to the text are shown with a **gray background** and deletions with **strikeout type**. Replacement pages numbered 15 through 19 incorporating the changes indicated above are attached hereto and incorporated herein by reference.

The Commissioner is authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 06-1300 (Our Order No. A-71184/DJB/MAK).

Respectfully submitted,

FLEHR, HOHBACH, TEST,
ALBRITTON & HERBERT LLP

Dated: 3 December 2001

By: Michael A. Kaufman
Michael A. KAUFMAN
Reg. No. 32,998

Embarcadero Center - Suite 3400
San Francisco, California 94111-4187
Tel.: (415) 781-1989
Fax: (415) 398-3249

SF-1069525v1

Serial No.: Not Yet Known
Filing Date: Herewith

VERSION WITH MARKINGS TO SHOW CHANGES MADE
IN THE CLAIMS:

Claims 4, 5, 6, 14, 23 and 24 were amended as follows:

4. A gas separator member according to claim 1 or claim 2 wherein the copper-based alloy comprises copper alloyed with up to a maximum of 50 wt%, preferably up to a maximum of or about 20 wt%, of one or more alloying elements selected from the group consisting of Al, Ni, Zn, Sn, Fe, Be, Ag, Au, Mn, Si, P, and Pb.
5. A gas separator member according to any one of the preceding claims claim 1 wherein the layer of oxidation resistant material has a thickness in the range of about 50 to about 1000 microns, preferably up to 200 microns, more preferably up to 100 microns.
6. A gas separator member according to any of the preceding claims claim 1 wherein the layer of oxidation resistant material is selected from the group consisting of a foil attached to the layer of copper or copper-based alloy, a coating on the layer of copper or copper-based alloy and a substrate onto which the layer of copper or copper-based alloy is coated.
14. A gas separator member according to any one of the preceding claims claim 1 which includes a protective layer on the anode side of the layer of copper or copper-based alloy.
23. A gas separator member according to claim 21 or 22 having a thickness in the range of from about 1mm to about 4mm, preferably to about 2mm.

Serial No.:: Not Yet Known
Filing Date: Herewith

24. A gas separator member according to ~~any one of claims 21 to 23~~ ~~claim 21~~ which has been heated to at least 650°C to form an alumina surface layer on a cathode side and, optionally, on an anode side thereof.

IN THE ABSTRACT OF THE DISCLOSURE:

The following text was added:

ABSTRACT OF THE DISCLOSURE

A fuel cell includes a copper-based gas separator that comprises a layer of solid oxide electrolyte, an anode layer, and a cathode layer. The gas separator member has an anode side and a cathode side that has a layer of copper or copper-based alloy that includes a layer of oxidation-resistant material. Surprisingly such copper-based gas separators do not poison the anode and benefit from the high thermal conductivity of the copper material.

- 15 -

CLAIMS:

1. A gas separator member for a fuel cell comprising a layer of solid oxide electrolyte, an anode layer and a cathode layer, the gas separator member having an anode side and a cathode side and comprising a layer of copper or copper-based alloy having a layer of oxidation-resistant material on the cathode side.
5
2. A gas separator member according to claim 1 wherein the layer of copper or copper-based alloy has a thickness in the range of from about 0.1mm to about 4mm.
10
3. A gas separator member according to claim 2 wherein the layer of copper has a thickness in the range of from about 0.1mm to about 1mm, preferably about 0.25mm to about 1mm, more preferably from about 0.4mm to about 0.7mm.
15
4. A gas separator member according to claim 1 wherein the copper-based alloy comprises copper alloyed with up to a maximum of 50 wt%, preferably up to a maximum of or about 20 wt%, of one or more alloying elements selected from the group consisting of Al, Ni, Zn, Sn, Fe, Be, Ag, Au, Mn, Si, P, and Pb.
20
5. A gas separator member according to claim 1 wherein the layer of oxidation resistant material has a thickness in the range of about 50 to about 1000 microns, preferably up to 200 microns, more preferably up to 100 microns.
25
6. A gas separator member according to claim 1 wherein the layer of oxidation resistant material is selected from the group consisting of a foil attached to the layer of copper or copper-based alloy, a coating on the layer of copper or copper-based alloy and a substrate onto which the layer of copper or copper-based alloy is coated.
30
7. A gas separator member according to claim 6 wherein the layer of oxidation-resistant material is a foil or a substrate and comprises a heat resistant steel.

- 16 -

8. A gas separator member according to claim 7 wherein the heat resistant steel is coated with alumina on the cathode side.
9. A gas separator member according to claim 7 wherein the heat resistant steel contains at least 4 wt% aluminium and forms a surface layer of alumina at least at the operating temperature of the fuel cell.
10. A gas separator member according to claim 6 wherein the layer of copper or copper-based alloy is coated with plural layers on the cathode side which together form the layer of oxidation-resistant material.
11. A gas separator member according to claim 6 wherein the oxidation resistant material comprises Al_2O_3 applied to the layer of copper or copper-based alloy as an alumina coating.
12. A gas separator member according to claim 6 wherein the oxidation resistant material comprises Al_2O_3 applied to the layer of copper or copper-based alloy as an aluminum coating which is subsequently oxidised.
- 20 13. A gas separator member according to claim 12 wherein the aluminium coating is at least partly diffused into a cathode-side surface portion of the layer of copper or copper-based alloy prior to being oxidised.
- 25 14. A gas separator member according to claim 1 which includes a protective layer on the anode side of the layer of copper or copper-based alloy.
- 30 15. A gas separator member according to claim 14 wherein the protective layer is of heat resistant steel which may optionally be coated with alumina on the anode side or contain at least 4 wt% aluminum so as to form a surface layer of alumina at least at the operating temperature of the fuel cell.

- 17 -

16. A gas separator member according to claim 15 wherein the heat resistant steel protective layer is in the form of a foil.
17. A gas separator member according to claim 14 wherein the protective layer comprises
5 Al_2O_3 applied to the layer of copper or copper-based alloy as an alumina coating.
18. A gas separator member according to claim 14 wherein the protective layer comprises
 Al_2O_3 applied to the layer of copper or copper-based alloy as an aluminum coating
which is subsequently oxidised.
10
19. A gas separator member according to claim 18 wherein the aluminum coating is at least
partly diffused into an anode-side surface portion of the layer of copper or copper-based
alloy prior to being oxidised.
- 15 20. A gas separator member according to claim 14 wherein the protective layer is made up
of plural layers, namely a metal barrier layer applied to the layer of copper or copper-
based alloy and formed of a material selected from the group consisting of W, Ta, Nb
and an alloy of one or more of said metals which do not dissolve into the layer of
copper or copper-based alloy, an intermediate layer of Ag on the metal barrier layer,
20 and a barrier layer on the intermediate layer formed of a metal selected from the group
consisting of Ni, a noble metal except Ag and an alloy of one or more of Ni and noble
metals except Ag.
21. A gas separator member for a fuel cell comprising a layer of solid oxide electrolyte, an
25 anode layer and a cathode layer, the gas separator member being formed of aluminium
bronze.
22. A gas separator member according to claim 21 wherein the aluminium bronze contains
at least 5 wt% Al.
30
23. A gas separator member according to claim 21 having a thickness in the range of from
about 1mm to about 4mm, preferably to about 2mm.

- 18 -

24. A gas separator member according to claim 21 which has been heated to at least 650°C to form an alumina surface layer on a cathode side and, optionally, on an anode side thereof.
- 5 25. A planar fuel cell stack including at least two planar solid oxide fuel cells each having a layer of solid oxide electrolyte, an anode layer on one side of the electrolyte layer and a cathode layer on the other side of the electrolyte layer, and a respective gas separator member between the at least two fuel cells, wherein the or each gas separator member is in accordance with any one of the preceding claims.

- 19 -

ABSTRACT OF THE DISCLOSURE

A fuel cell includes a copper-based gas separator that comprises a layer of solid oxide electrolyte, an anode layer, and a cathode layer. The gas separator member has an anode side
5 and a cathode side that has a layer of copper or copper-based alloy that includes a layer of oxidation-resistant material. Surprisingly such copper-based gas separators do not poison the anode and benefit from the high thermal conductivity of the copper material.

10

15

20

25

30